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What has just been said is not intended in any way to criticise, or belittle the importance and value of the "pure-bred" registry system of developing the live-stock industry of the world. I merely wish to point out that when he adopted the system, the animal breeder took upon himself along with the advantages certain very real restrictions to the freedom of his breeding operations, which the plant breeder has escaped. The animal-breeding industry of the world has developed as a system of pedigreed aristocracy. The plant-breeding industry is developing as a democracy. The "social position" of a horse or a cow is primarily determined on the basis of whether it had a grandfather or not. A variety of oats takes its place in the world by virtue of its own inherent qualities, with no questions asked about forebears or the orthodoxy of their marital relations. Both aristocracies and democracies have their advantages and their disadvantages as social systems. These merits and defects are just as real and effective in their operation whether the ultimate vital unit of the system be a man, a cow or an oat plant.

Owing to the essentially different conditions and methods of work which obtain in plant breeding, this field is able to reap more direct benefits of a practical character from the advances which have been made in the science of genetics, than is animal breeding. In the creation of new races by hybridization the plant breeder can and does take Mendelian principles as a direct and immediate guide. He has made Mendelism a working tool of his craft.

To conclude: What I have tried to do in this paper is to discuss the relation between the science of genetics and the practical art of breeding as they actually have developed and now exist. Your attention has been directed to the obvious fact that animal breeding has, without the aid of genetic

science, attained an extremely high level of achievement. Empirical methods can only have been successful when they were fundamentally in accord with natural laws, and it is therefore not to be considered surprising that the recent discoveries of world-old genetic laws have not radically modified the successful animal breeders' methods. In pointing out that a scientifically trained geneticist is not as yet an absolutely indispensable necessity on a successful animal breeding farm I have no thought or desire to belittle the importance of the science of genetics. My zeal and enthusiasm for the advance of knowledge in this field know no bounds. This attitude, however, furnishes no reason that the geneticist should delude himself, or by rash statements hold out false hopes to the breeder, as to the immediate practical importance of some of the recent developments in the science of genetics. All knowledge is potentially useful, but the fundamental reason for undertaking and encouraging research in genetics, or anything else, is not because what one gets may be useful, but because it is *knowledge*.

RAYMOND PEARL

MAINE AGRICULTURAL EXPERIMENT STATION

THE METAMORPHOSIS OF THE CARNEGIE FOUNDATION

THAT part—a relatively small part—of the new annual report of the Carnegie Foundation which deals with the affairs of the foundation itself, is significant chiefly as showing that the president of the foundation, at least, has already abandoned most of those principles which at the outset were generally understood to govern the foundation's policy with respect to retiring allowances. It is worth while to recall what some of those principles were.

1. The primary purpose of the pension system was to be, not to relieve deserving and necessitous college teachers in their old age, but to better the profession as a whole, "to attract into it increasing numbers of strong

men"¹ and to increase its "social dignity and stability," by increasing the eventual reward of those who continue long in it and reach professorial rank in institutions of sound educational standards. This was laid down as one of the "two fundamental principles" in the first annual report. President Pritchett therein wrote:

In the long run, men's personal preference for the work of the teacher . . . can not be depended on to secure an adequate supply of the best men. This fact the older European countries long ago recognized, and in order to secure for the place of teacher the best men, they have sought to dignify the profession of the teacher by the highest social and official honors; and they have sought in addition to strengthen it by larger financial rewards. And inasmuch as the salaries of the teachers can not be made equal to those of outside professions this reward has come, in the main, by the establishment of a system of pensions. . . . In other words, the first and largest ground for the establishment of systems of retiring pensions for teachers has been found in a wish to strengthen the teaching profession.²

2. As a necessary consequence of the preceding, a second principle repeatedly enunciated in the earlier reports was that the retiring allowance "should come as a matter of right, not as a charity." President Pritchett wrote in 1906:

No ambitious and independent professor wishes to find himself in the position of accepting a charity or a favor, and the retiring allowance system simply as a charity has little to commend it. It would unquestionably relieve here and there distress of a most pathetic sort, but, like all other ill-considered charity, it would work harm in other directions. It is essential, in the opinion of the trustees, that the fund shall be so administered as to appeal to the professors in American and Canadian colleges from the standpoint of a right, not from that of charity, to the end that the teacher shall receive his retiring allowance on exactly the same basis as that upon which he receives his active salary, as a part of his academic compensation.

3. One of the purposes especially emphasized in the first report was that of "freshen-

ing the work of the colleges themselves by enabling them to put new men into the places of those whom old age or disability has rendered unfit for service."³

4. Pensions were to be granted on three grounds, old age, length of service and disability. Sixty-five years was specified as the limit of age and twenty-five years in professorial grades "as the limit of service upon which a pension may be earned." Widows of professors were to receive one half the allowances to which their husbands would have been entitled.

Upon these points the opinions of President Pritchett have by this time singularly changed. It will be convenient, in noting these changes, to take up the points in reverse order.

4. (a) The service-pension provisions of the foundation were, as is generally known, abolished without warning in 1909; that is an old story, little creditable to the executive authorities of the foundation, to which it would not now be needful to recur, did not President Pritchett repeat certain aspersions (already made in the fourth report) upon the members of the profession who became entitled to, and accepted, those pensions prior to 1910; and did he not misrepresent the original policy of the foundation in this matter. Dr. Pritchett now writes:

The service-pension rule was adopted by the trustees under the assumption that but few applications would be made under it, and that these would be in the main applications from men who were disabled for further service. The intention was, in fact, to use the rule as a disability provision. The outcome showed what might have been clearly foreseen at the beginning, that college presidents and college teachers can no more rise above the ordinary appeal of self-interest than other educated and intelligent men. . . . It has been discouraging at times to find men in the early fifties, in the prime of health and strength, applying for pensions upon trivial and selfish grounds in order to escape from teaching.⁴

¹ First report, p. 37.

² *Ibid.*, p. 31.

³ *Ibid.*, p. 7.

⁴ Seventh report, pp. 82-84.

This passage is at once a misleading account of the original service-pension policy of the foundation, and a peculiarly discreditable act of injustice to the seventy gentlemen who received service pensions (in "accepted institutions") under the former rules. It is to be supposed that if the trustees had in 1906 the intentions now retrospectively ascribed to them, they had sufficient access to dictionaries of the English language to be able to give some expression to those intentions. But in fact, they gave no hint then, or in the following years, that they meant the service-pension to be subject to any other limitations than those clearly specified in the rules; and they plainly indicated they did *not* regard it as a disability pension, since, in the annual records of retiring allowances granted, three classes have from the first been distinguished—those granted "on basis of age," "on basis of service," and "on basis of disability." What the foundation did was to declare that a certain number of years constituted "the limit of service upon which a pension may be earned," the pension coming then "upon exactly the same basis as" the recipient's "active salary." Having offered pensions to a number of men on these definitely specified terms, President Pritchett now publishes reflections upon them for accepting the pensions upon those terms. It can not even be said (what Dr. Pritchett implies) that the recipients of service pensions had reason to know that they were taking "for their greater comfort pensions that would mean great relief to more needy teachers." For the first report gave assurance that the income was sufficient to provide for all professors in many more institutions than were on the accepted list; and that it was even hoped that after trial "a more generous scale of pensions" than that then in force could be adopted, "either by extending [*sic*] the limit of age or of service, or by increasing the amount of the individual pension."⁵

(b) It now becomes evident that, if the future policy of the trustees is to be guided by the views of the president, the old-age pension also is destined to great modification, and

⁵ First report, p. 15.

probably to abolition. Dr. Pritchett now writes on this as follows:

The experience of the foundation shows that the minimum age limit should be set higher than sixty-five. . . . Just what age is the best to set as a minimum limit it is difficult to say. The whole matter comes back to a *conception of the pension which is somewhat different from that which we all very naturally entertained at the beginning, that is, that the pension is not intended to assist the man of strong body and mind to get out of teaching at any assigned age, it is to take care of him when his powers fail and he can no longer do his work well.* To raise the limit of age works no hardship to the man who is broken in health at sixty-five. Such a man would be retired on the ground of disability. One places a different ideal before the teacher, moreover, when he suggests *retirement on the ground of approaching weakness rather than on the ground of a definite limit of age.*⁶

Thus the entire system of professorial pensions may be expected soon to be based upon only one—and that the last—of the three grounds originally recognized, viz., disability.

3. There naturally goes with this change an abandonment of the purpose of "freshening" the teaching in the colleges by facilitating the retirement (under the age limit) of men not physically disabled but of impaired efficiency.

The anticipation of college presidents that inefficient men could be disposed of by a pension has proven another delusion.⁷

2. As the foregoing suggests, Dr. Pritchett has already very nearly come to look upon the foundation over which he presides as essentially eleemosynary in its purpose. With some indirection, yet unmistakably enough, he intimates that, in his opinion, teachers possessing "an adequate or modest income" can not with entire propriety accept pensions. He finds that the teacher does *not* "receive his retiring allowance on exactly the same basis as that

⁶ Seventh report, p. 69; italics mine. It should be added that President Pritchett regards the plan of contributory pensions as the ideal one, though he does not definitely urge its adoption by the foundation.

⁷ Seventh report, p. 84.

upon which he receives his active salary." President Pritchett is, indeed, not quite able to forget his early insistence upon the principle that the foundation's pensions "come as a right, not as a charity." He therefore repeats this, and straightway unsays it.

While the trustees have sought, and rightly sought, to have teachers in the accepted institutions feel that the pension is a thing earned and not a charity, nevertheless it ought to be said that the acceptance of it does not stand upon quite the same basis as the acceptance of a salary, nor have teachers appreciated quite fully that their own attitude towards this gift and its use would have its effect upon educational giving and the estimation that the world puts upon the motives and ideals of teachers. The foundation would not in any respect diminish the feeling that the teacher, in an accepted institution, may accept the pension as a right, not as a favor. None the less it remains true that this is a free gift, and that the well-to-do man who accepts it thereby makes it impossible to extend the help of a pension to one who really needs it.*

A Carnegie pension, therefore, is hereafter to be regarded as a "right" which is at the same time "a free gift"; it is a thing earned which yet one ought not to accept if one already has a competency—a paradoxical entity indeed. President Pritchett does not thus far indicate that the trustees, before awarding pensions, mean to use the methods of the charity organization society in order to establish the fact of the applicant's poverty; though the past history of the foundation justifies no confidence that the rules will not in time be changed so as to provide for something of this sort. Nor, if poverty is really presupposed, ought the manner of establishment of the fact to be left undetermined. But for the present the question is left "for the individual himself to settle." The individual, however, receives a plain hint that he is expected to settle it only in one way. Thus the basis upon which pensions may, in President Pritchett's view, hereafter legitimately be applied for is not service rendered, but destitution. He would have them go exclusively to aged professors who are also disabled

and who "really need" such a "free gift" for their support, and to widows similarly in need.

1. All this means, of course, that the purpose which the early statements of the foundation gave as its chief reason for being has now been discarded altogether. This follows both from the particular nature of the changes already made or foreshadowed, and also from the fact, now abundantly evident, that, in general, constant change in its purposes and its rules is the most distinguishing feature of the foundation's conduct. The reward to be expected by the reasonably successful and thrifty member of the teaching profession will be in no degree increased, if the system is put upon the basis which President Pritchett now recommends. The "social dignity" of the profession will be in no way enhanced by the maintenance of a fund for the relief of destitute and disabled professors and their relicts, least of all, if it is to continue to be a feature of the foundation's policy to publish periodic animadversions upon persons who have accepted pensions to which the plain language of the rules seemed to entitle them, and if the annual reports are regularly to contain melancholy reflections on "the darker side of pension administration" and the surprising "selfishness" of many teachers. "Increasing numbers of strong men" are little likely to be attracted into the profession in their twenties by the expectation of receiving a "free gift" at nearly seventy, on condition that they are then incapacitated and without means of support—especially when they know that the corporation promising this gift reserves and frequently exercises the right to disappoint the expectations which it has aroused.

While the new report thus manifests a reversal of the principles originally adopted on these four essential points, it records one change which is more in keeping with those principles than has been the practise heretofore prevailing. Hereafter no new grants are to be made to persons not in "accepted institutions."

Though the relation of cause and effect is not altogether plainly avowed, the probable

* *Ibid.*, p. 83.

reason for all five of these changes of heart is to be sought in the foundation's financial situation. The actuarial calculations upon which the trustees based their original plans have proved far too sanguine. The first report estimated that the average pension under the rules then in force would be less than \$1,450. The present general average is \$1,677; of those in accepted institutions, about \$1,780. If it were not for the obligations assumed towards persons not in accepted institutions, even with this increase the pensions paid to the present number of professors or widows of professors in such institutions would leave a surplus out of the annual income of about \$200,000; as it is, there is an accumulation in the past year of some \$42,000. The present close approach of the foundation's expenditure to its income is thus chiefly due to the policy of making special grants, hereafter to be abandoned. But even with this charge in process of elimination, the time when claims for pensions, valid under the present rules, will far exceed income is clearly in sight. It was expected in 1906 that an income of \$500,000 would maintain an adequate pension system for between 100 and 120 colleges—as many as were thought likely to come upon the accepted list. At present the providing of pensions—with the service-pension abolished—for 72 institutions only, requires an expenditure of \$478,440; and it is estimated that “at the end of a generation,” if the existing rules should remain unchanged, the claims to pensions *coming from these institutions alone—assuming their faculties to remain stationary in number and the average age of retirement to be sixty-nine*—would call for annual payments of \$1,375,000. The foundation's total income, “when the whole of the gifts already made to it by the founder are paid in, will amount to approximately \$800,000.”⁹ Consequently, if the endowment is not increased, the rules for the granting of pensions will inevitably have to be so modified as to reduce greatly the average amount allowed, or the number of valid claims, or both.

In so far, then, as the changes of policy now

⁹ *Ibid.*, p. 92.

suggested are designed to meet this future contingency, they may claim the justification of necessity. In attempting to provide pensions, upon the excellent principles originally proposed, for so large a number of institutions, the foundation was attempting a thing impossible with the funds at its disposal. That its impossibility was not foreseen at the outset by the officials of the foundation is amazing. It is true, as President Pritchett constantly remarks, that no complete data bearing upon exactly the foundation's problem were available in 1906. But most of the recently gathered facts with regard to the number, rate of increase of number and of salaries, and age-distribution, of teachers in accepted institutions, upon which facts the present calculations are based, could equally well have been obtained six years earlier; and their indispensableness was then equally obvious. The report of Messrs. Pritchett and Vanderlip¹⁰ upon which the original estimates appear to have been largely based, actually contained no reference to the all-important factor of age-distribution in the case of men not yet of pensionable age. It implied, for example, that the number of professors over 65 in 1905 would approximately indicate the number of the same class in subsequent years. It would be hard to imagine an actuarial error more glaring or more easily avoidable. This error, and the insufficiency of the foundation's endowment for its announced intentions, were clearly pointed out by Professor Cattell in *SCIENCE* four years ago.

If, then, the foundation (or its president) has within six years abandoned most of its original ideals, and if the university teachers of America have generally lost confidence in the stability of the foundation's policy and the trustworthiness of its promises, this disappointing outcome is the natural consequence of the initial adoption of a program manifestly impossible with the available endowment. The mistake in that program did not consist in its essential principles; it consisted in making the rules completely retroactive; in authorizing special grants; and above all in

¹⁰ First report, pp. 10-16.

attempting to provide for too many colleges. President Pritchett in his first report justly remarked:

No one can doubt that the establishment of an effective system of retiring allowances in one hundred institutions will contribute vastly more to the introduction of the retiring-pay principle in American education than the maintenance of a charitable fund for a much larger number of institutions.

But the "one hundred" in this sentence was itself far too large a number. The final result, now definitely foreshadowed, of this original over-estimate seems likely to be that the foundation will in time be nothing more or less than a charitable fund for from seventy-five to one hundred institutions.

A charitable fund, no doubt, will have its uses; it will mean relief from anxiety and distress for a considerable number of worthy and unfortunate people connected with our colleges. But it will render none of those services to "the advancement of teaching" which were once understood to be the chief function of the foundation.

It is, however, possibly even now not too late for a return to first principles—though it, like any other course of action now open to the foundation, would probably involve some hardship. Let the foundation add no more colleges to its "accepted list"; let it, if actuarial analysis should show this to be feasible, announce that all professors who now have legitimate expectations of pensions under the present rules will have those expectations duly realized; or if, as is probable, this is financially impossible, let it provide that at least all now over forty-five or fifty years of age will have their claims met as they mature. But for all others let the present rules be temporarily abrogated. Let the foundation then select carefully a much smaller number of colleges, on the basis of educational standards, geographical situation, and certain other considerations. Let it then, after thorough actuarial study, establish for these institutions a stable system of retiring allowances, *upon the general principles which the foundation first laid down*, with the further requirement that

the institution shall contribute a part of each pension, and without requiring absolute cessation of academic activity. These things done, the great initial error would be largely corrected, and the foundation's original purposes would be realized in the measure which its endowment permits.¹¹ Such a plan would indeed do more not only to establish the "retiring-pay principle," but also to increase the attractiveness, the dignity and the efficiency of the college-teaching profession, than would "the maintenance of a charitable fund for a much larger number of institutions."

It may be, however, that a still more thorough statistical analysis than has yet been made would show that the resources of the foundation will not support such a system for more than an extremely small number of colleges. If this should prove to be the case, there might be defensible grounds for a decision to maintain thereafter, for a larger number, disability-pensions only. But if the foundation should be reduced to this necessity, pensions should be granted for disability (to persons genuinely committed to the teaching profession) at any period of life, or to professors' widows, whatever the age of the husband at the time of death. A disability-pension system is likely to serve the most urgent need precisely in case of break-down or sudden death in middle life, while the family suffering such misfortune still has young children to be educated and before the accumulation of considerable savings has been possible. Furthermore, whatever pensions are provided for should be granted to legitimate applicants without special presumption of poverty. Such a plan, in my opinion, should be the last resort of the foundation; and if adopted it should be frankly recognized as what it is. Yet even it would be preferable to a scheme of the equivocal sort which the president of the foundation now appears to regard with favor.

¹¹ Another possible solution which merits consideration would be to use the income to aid institutions to establish pension systems. The reasons given (p. 79) for the original rejection of this plan do not seem conclusive.

But the most needful change in the pension policy of the foundation is a cessation of change. The worst possible trait in any system of annuities or insurance is the trait which has hitherto conspicuously characterized the administration of those who have had Mr. Carnegie's great gift in their charge—untrustworthiness. Whatever else it is, a pension system should be a thing which can be depended upon, to which men can adjust their plans with confidence. All its dealings should be marked by an *uberrima fides*. Its rules should be definite and comprehensive; and they should not subsequently have read into them meanings contrary to their natural sense. It is imperative, therefore, that the foundation take the necessary measures to ensure the stability of its policy. It should first of all determine with the utmost care and thoroughness what it is financially able to do. It should thereafter confine its promises within the limits of its possibilities. It should then keep the promises it makes.

ARTHUR O. LOVEJOY

GEORGE HAROLD DREW

GEORGE HAROLD DREW, B.A., of Cambridge, one of the most brilliant of the younger biologists of England, died suddenly on January 30, 1913.

He was the only son of George Samuel Drew, Esq., of Paignton, Devon; and was born on October 23, 1881, and educated at New College, Eastbourne.

He was entrance exhibitor at Cambridge in 1900 and was elected in June, 1901, to a scholarship in the university, where he paid special attention to the natural sciences and to the more scientific aspects of the medical courses. In 1906 he obtained a scholarship in St. Mary's Hospital, and in 1908 he studied in the Marine Biological Station at Plymouth and was also lecturer in biology in the Plymouth Technical School. In 1910 he was appointed Beit memorial fellow in medical research for the zoological department of cancer, and in 1912 he was elected to the John Lucas Walker studentship for pathology in the University of Cambridge, and on January

1, 1913, he was appointed research associate in the department of marine zoology of the Carnegie Institution of Washington.

He was distinguished not only for his remarkable breadth of knowledge, but even more so for a rare aptitude and insight into methods of research which, had his life been spared, would have led to his name being known among the very few of England's great men of science; but in the springtime of his high promise he passed away and the all but unheeding world has lost a great leader who was to be.

He was the author of only fifteen papers, yet among them are some notable contributions to science.

In coral reef regions naturalists have long been familiar with the vast areas covered with finely divided limestone which has commonly been called "coral mud." In 1910, however, Vaughan stated that these limestone muds appeared to be of chemical origin, and in 1911 Drew discovered that there is in the warm surface waters of the tropical Atlantic a bacillus which is exceedingly abundant and which denitrifies the sea water, thus enabling the dissolved carbon dioxide to combine with the calcium and to form a precipitate of calcium carbonate.

Thus the vast beds of limestone which in coral reef regions are often hundreds of feet in thickness and thousands of square miles in area are formed mainly through the activity of Drew's bacillus.

Moreover, the presence of this denitrifying bacillus in tropical seas accounts for the paucity of sea-weeds in the warm oceans, and the blue color of "coral seas" may in some measure at least be due to the presence of the finely divided particles of calcium carbonate suspended in the water.

Recent studies by Vaughan appear to indicate that oolite is ultimately formed from this precipitated calcium by attraction of the particles to the films of gas bubbles, or to solid nuclei, in the manner described by Linch.

Drew's interest, however, extended to subjects other than those of oceanography; for